Intelligent Systems for Engineers and Scientists

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Abstract

INTRODUCTION Intelligent Systems Knowledge-Based Systems The Knowledge Base Deduction, Abduction, and Induction The Inference Engine Declarative and Procedural Programming Expert Systems Knowledge Acquisition Search Computational Intelligence Integration with other Software RULE-BASED SYSTEMS Rules and Facts A Rule-Based System for Boiler Control Rule Examination and Rule Firing Maintaining Consistency The Closed-World Assumption Use of Variables within Rules Forward-Chaining Conflict Resolution Backward-Chaining A Hybrid Strategy Explanation Facilities DEALING WITH UNCERTAINTY Sources of Uncertainty Bayesian Updating Certainty Theory Fuzzy Logic Other Techniques OBJECT-ORIENTED SYSTEMS Objects and Frames An Illustrative Example Introducing OOP Data Abstraction Inheritance Encapsulation Unified Modeling Language (UML) Dynamic (or late) Binding Message Passing and Function Calls Type Checking Further Aspects of OOP Frame-Based Systems INTELLIGENT AGENTS Characteristics of an Intelligent Agent Agents and Objects Agent Architectures Multiagent Systems SYMBOLIC LEARNING Introduction Learning by Induction Case-Based Reasoning OPTIMIZATION ALGORITHMS Optimization The Search Space Searching the Search Space Hill-Climbing and Gradient Descent Algorithms Simulated Annealing Genetic Algorithms NEURAL NETWORKS Introduction Neural Network Applications Nodes and Interconnections Single and Multilayer Perceptrons The Hopfield Network MAXNET The Hamming Network Adaptive Resonance Theory (ART) Networks Kohonen Self-Organizing Networks Radial Basis Function Networks HYBRID SYSTEMS Convergence of Techniques Blackboard Systems Genetic-Fuzzy Systems Neuro-Fuzzy Systems Genetic Neural Systems Clarifying and Verifying Neural Networks Learning Classifier Systems TOOLS AND LANGUAGES A Range of Intelligent Systems Tools Expert System Shells Toolkits and Libraries Artificial Intelligence Languages Lisp Prolog Comparison of AI Languages SYSTEMS FOR INTERPRETATION AND DIAGNOSIS Introduction Deduction and Abduction for Diagnosis Depth of Knowledge Model-Based Reasoning Case Study: A Blackboard System for Interpreting Ultrasonic Images SYSTEMS FOR DESIGN AND SELECTION The Design Process Design as a Search Problem Computer Aided Design The Product Design Specification (PDS) Conceptual Design Constraint Propagation and Truth Maintenance Case Study: The Design of a Lightweight Beam Design as a Selection Exercise Failure Mode and Effects Analysis (FMEA) SYSTEMS FOR PLANNING Introduction Classical Planning Systems STRIPS Considering the Side Effects of Actions Hierarchical Planning Postponement of Commitment Job-Shop Scheduling Constraint-Based Analysis Replanning and Reactive Planning SYSTEMS FOR CONTROL Introduction Low-Level Control Requirements of High-Level (Supervisory) Control Blackboard Maintenance Time-Constrained Reasoning Fuzzy Control The BOXES Controller Neural Network Controllers Statistical Process Control (SPC) CONCLUDING REMARKS Benefits Information Trends INDEX